

## **APPENDIX 33**

**TO:** David K. Paylor  
**FROM:** Alan E. Pollock  
**DATE:** July 20, 2010  
**COPIES:** Ellen Gilinsky  
**SUBJECT: CONCERNS WITH JULY 1 DRAFT NUTRIENT ALLOCATIONS  
FOR THE JAMES RIVER BASIN BASED ON CHLOROPHYLL  
CRITERIA**

#### **EXECUTIVE SUMMARY**

- Proper assessment of model output must recognize the significant spatial and temporal variability of chlorophyll levels, in contrast to the more predictable dissolved oxygen patterns.
- EPA recognized this variability during the cooperative development process for the chlorophyll criteria in 2005, and included significant modeling evaluation of alternatives to address this issue. EPA approved the Virginia criteria based upon model assessment rules appropriate for chlorophyll attainment, in contrast to the rules that were used to develop the July 1 James River draft allocations.
- Recent information from the lower tidal James River 2010 Water Quality Assessment shows attainment, or at most 1% non-attainment, for those river segments. The expected reductions needed to meet the "dissolved oxygen-based" James River allocation [TN = 26.79 MPY; TP = 2.69 MPY] should achieve the criteria in this portion of the river without the additional reductions proposed by EPA.
- The additional reductions identified in the July 1 letter, which we do not believe are justified at this time, would increase costs to the citizens of the Commonwealth upwards of \$500 million.
- Based on model results received from EPA in the past few days, absent the imposition of the chlorophyll issue in the James, the Virginia Tributary Strategy level of reductions would meet the draft nutrient allocations assigned to the Commonwealth.

#### **CONCERNS WITH JULY 1 DRAFT NUTRIENT ALLOCATIONS FOR JAMES RIVER BASIN**

- I. Methodology used to Develop Draft Allocations to Meet Chlorophyll Criteria is Not  
Appropriate

- Chlorophyll model calibration is difficult due to its high natural variability. Caution must be taken in evaluating model results as the basis for assessing attainment and setting nutrient allocations for compliance with chlorophyll criteria.
- Concern that changes in chlorophyll (on the order of 1-2 ug/l seasonal average and 2-4% in terms of non-attainment rates) are smaller than those than can be precisely distinguished by the model, detected in monitoring data, or concluded to have ecological significance.
- The rules and procedures to assess model output need to be carefully examined to see what is appropriate for the chlorophyll parameter in contrast to what is appropriate for dissolved oxygen. Refer to **Attachment A** which summarizes the differences between these two parameters regarding precision of analytical methods, confidence of impairment, environmental variability, etc. For the Bay TMDL, EPA is using a "1% non-attainment rule" when evaluating model scenario output for judging dissolved oxygen attainment. We have not yet seen EPA's documentation to justify using the "1% non-attainment rule" for interpreting model results for dissolved oxygen. However, we continue to be concerned that using the "1% non-attainment rule" for modeling attainment for chlorophyll, given the significant differences in these parameters, is not technically justified.

As discussed in more detail below under section II, when the chlorophyll standards were adopted in 2005, EPA endorsed using model assessment rules different from the rules used to establish the July 1 draft allocations. Model predictions allowed up to a 4% non-attainment rule for assessing attainability with the proposed standards for several of the criteria.

- **Attachment B** presents the results of the 2008 and 2010 Water Quality Assessments for the chlorophyll criteria in the tidal James River. The following conclusions are drawn by using the results of the 2010 Assessment [data from 2006-08] and the assessment procedures developed by EPA (2010) and being adopted into the Virginia Water Quality Standards, i.e., the far right column, **2010 IR Geo Mean Status**.
  1. The three lower James River segments for both spring and summer either attain standards, or are within 1% non-attainment. The most recent model results as analyzed by EPA show non-attainment in at least one season in these three segments for several 3-year cycles under the allocations based on meeting the dissolved oxygen criteria [TN = 26.79 MPY; TP = 2.69 MPY].

Based on recent emails from EPA staff, we understand that in developing the proper allocations to address the chlorophyll criteria in the DC Potomac and Anacostia Rivers, EPA used additional lines of evidence, not just model output and data from the 1990s. One email stated: "For the [P]otomac, the current *monitoring* data showed the [P]otomac is in attainment for Chl[orophyll] and the [A]nacostia is only 4% non-attainment. That information combined with the fact that the [P]otomac allocation still requires additional load reductions beyond current loads made us conclude that these segments will attain for chl[orophyll] at the allocated load." It appears to us that a consistent line of evidence

approach should be used for the lower James River segments where most recent data shows that they are currently either in attainment or at 1% non-attainment.

2. The 2010 Assessment shows non-attainment in both the James upper and lower Tidal Fresh segments for both seasons, especially for the summer season. However, for the upper Tidal Fresh segment, the model is showing attainment in both seasons for all of the 3-year cycles. For the lower Tidal Fresh in the spring, the model shows slight 2% non-attainment. For the lower Tidal Fresh in the summer, the model shows persistent non-attainment in half of the 3-year cycle periods.

Given this situation, we have little confidence in using the model to assess attainment in these tidal fresh segments. The main conclusion we draw is that the monitoring data are still pointing us towards the real chlorophyll problem in the James, which is the tidal fresh sections, particularly the lower tidal fresh in the summer. As discussed in section II, Virginia needs to review the summer tidal fresh criteria, particularly the application of the Harmful Algal Bloom criteria published by EPA. We believe if EPA used the same model assessment rules for the 2010 TMDL that were used in the standards adoption process in 2005, Virginia would have the opportunity to conduct the necessary review and update of the chlorophyll criteria without unjustified allocations in the 2010 TMDL.

- For chlorophyll, EPA is assessing model results by requiring attainment throughout the entire 10-year modeling assessment period, i.e., the criteria must be met in all eight 3-year cycles. However, EPA worked through a consensus process that identified one 3-year cycle that accounts for critical conditions in setting allocations for dissolved oxygen criteria. They are also doing the same for SAV/clarity criteria.

We continue to be concerned that the critical condition approach used for the chlorophyll criteria is overly conservative by requiring compliance in every assessment cycle over the entire model simulation period, especially compared to the other two water quality criteria in the Bay. In addition, as noted in section II below, when Virginia adopted the chlorophyll standards in 2005, EPA endorsed using model assessment of attainability for both a ten year average, as well as looking at the rolling 3-year averages.

- We are concerned over the lack of examination of the same problems that cause counterintuitive model results in some segment-seasons might also be causing more systematic, less obvious problems in other segment-seasons. We believe there is a need to develop a set of objective criteria for evaluating model behavior that includes: (1) a systematic evaluation of the ability of the model to quantify changes in chlorophyll; and (2) an evaluation of the causes of problematic model chlorophyll predictions, and how those causes might affect the model accuracy/precision in all of the James River segments for both spring and summer seasons.
- It is doubtful that Virginia would have taken the step of being the first to adopt numeric chlorophyll criteria if EPA had applied the model attainability rules currently being used, i.e. 1% non-attainment rule and requiring attainment in all 3-year assessment cycles in the simulation period.

## II. Need to Acknowledge the Basis for the Existing James River Chlorophyll Criteria and the Need to Review/Update those Criteria

- In March 2005, the State Water Control Board adopted water quality standards to protect the Chesapeake Bay and tidal rivers; these standards included five new designated uses, numeric criteria for dissolved oxygen, SAV and water clarity, and a narrative chlorophyll criterion. Action on numeric chlorophyll criteria for the tidal James River was delayed to give further consideration to public comments and to develop nutrient loading and cost alternative analyses. The Board considered the James River chlorophyll criteria at their June 2005 meeting, and adopted criteria at their November 2005 meeting.
- Earlier in the decade EPA chose not to develop Baywide numeric chlorophyll criteria following extensive review, scientific investigation and debate within the Chesapeake Bay Program. Therefore, the cooperative process between the Commonwealth and EPA to develop the chlorophyll criteria for the James River was “plowing new ground”. The process resulted in new investigation, using several lines of evidence, such as reference sites, information on harmful or nuisance aquatic plant life, undesirable food conditions, natural characteristics of the James River, and attainability of criteria under various nutrient reductions in the basin.
- Much debate and controversy developed among the stakeholders during the rulemaking process. Legislation drafted by a member of the General Assembly, that would require justification of tangible benefits to the environment and the public, was held in abeyance as long as a solution agreeable to all parties was achieved. Considerable work was devoted to developing and analyzing alternatives with the EPA model to meet various proposed criteria within the five river segments and two seasons. A **James River Alternatives Analysis**, along with four addenda, was developed and became the focus of the on-going debate. EPA model analysis of alternatives, and the model results, became the center of debate throughout this process.
- EPA presented model output, and worked alongside DEQ and the stakeholders in evaluating that model output for the alternatives, in the following ways:
  - Model output was evaluated using 10 year averages of attainment over the assessment period of 1985 to 1994
  - Model output was evaluated without any rule calling for attainment throughout all eight 3-year cycle periods
  - Model output was evaluated without any rule calling for less than 1% non-attainment.
- Based upon that partnership work, DEQ staff, by memo dated June 22, 2005 to the State Water Control Board, in describing the results of the various alternatives evaluated up to that time, stated: *“However, most of the non-attainment under the VATS scenario was less than 4%, which staff believes is within the uncertainty band of the model....”*

- Seventeen alternatives were evaluated by the time the Board adopted the criteria. The final proposal presented to the Board at their November 21, 2005 meeting, which EPA supported, addressed the ten segment-season criteria as follows:
  - Four criteria included upward adjustments from original proposed criteria, using the rationale of “attainability but still within environmentally protective ranges”
  - Two criteria remained unchanged showing non-attainment of 3-4%
  - Four criteria remained unchanged showing attainment
- DEQ submitted the adopted chlorophyll criteria, and supporting documentation to EPA, on January 12, 2006, noting that “Each of these site-specific standards was developed with EPA Region 3 input and assistance.”
- EPA approved these criteria by letter dated, January 12, 2006. Approving these standards the same day is a clear indication that EPA was fully involved and aware of the basis for the chlorophyll criteria and supported that process.
- Likewise, EPA provided written support for a related regulatory action during that same period when the State Water Control Board amended the Virginia Water Quality Management Planning regulation to incorporate nutrient allocations for 125 significant discharges, including those within the James River basin to achieve the adopted chlorophyll standards. EPA’s letter stated: “The allocations are supportive of Virginia’s proposed chlorophyll *a* water quality criteria for the tidal James River and its tidal tributaries.”
- Subsequent to the previously described actions, EPA also approved the Chesapeake Bay Watershed General Permit, effective date of January 1, 2007, that included the allocations in the WQMP regulation.
- The Commonwealth clearly understands that the science is evolving regarding the use of chlorophyll criteria in the management of nutrient enrichment of our waters. We intend to initiate a review of the criteria during our next Triennial Review to evaluate any new science and recent monitoring data. We also know that EPA has published criteria to address harmful algae blooms in tidal fresh waters during the summer season. That information will be closely reviewed since the lower tidal fresh segment of the James continues to be an area of concern. We also believe that a full evaluation of the proper assessment tools is warranted, for both monitoring and modeling data.

### III. Impacts to Virginia Programs

- Reducing an additional 3.3 MPY of Nitrogen and 0.35 MPY of Phosphorus in the James River basin as called for by the July 1 draft allocations is estimated to cost upwards of an additional \$500 Million beyond the cost of implementing Tributary Strategy level of practices.
- Based on our experience during the criteria development process, we are concerned that EPA’s July 1 letter will open up the Bay TMDL process in Virginia to legislative response. We are also concerned that the clean-up effort in the Commonwealth will be delayed due to appeals of the TMDL over the July 1 draft allocations.

## Attachment A

### Comparison of Chlorophyll vs. D.O.

Characteristic	Chlorophyll	Dissolved Oxygen	Implication for Assessment and TMDL
Criteria Parameter Type	Biological Stressor (i.e. Algal Biomass)	Chemical Stressor (i.e. Oxygen Concentration).	<i>Chlorophyll assessment/TMDL less accurate and precise.</i>
Impairment Confidence	Lower: Based on relatively difficult to quantify standard of "balanced and indigenous population"	Higher: Based on controlled laboratory studies of direct impact on living organisms. e.g. observed health or death of organisms.	<i>Chlorophyll assessment/TMDL Impairment level less accurately defined.</i>
Criteria Evolution	Newer EPA publications since 2005; science still developing	No Change Since 2005	<i>Chlorophyll criteria should be revised.</i>
Criteria Metric	Seasonal geometric mean	30 day, 7-day, 1-day, averages; instantaneous	<i>Chlorophyll assessment/TMDL less precise (Due to longer averaging period)</i>
Parameter Analysis Method	Multi-step Laboratory analysis	Electronic field meter	<i>Chlorophyll assessment/TMDL data less accurate and precise.</i>
Data Quantity/Quality Trends	Model is using data collected in 1990's; collection and analysis methods have changed since that time	Methods are high quality; have not changed since beginning in 1985	<i>Chlorophyll TMDL data less accurate and precise.</i>
Analytical Method Variability	Higher (16%: median relative percent difference between intra-laboratory splits in James River during 1990's)	Lower (0.7%: ratio of precision [Standard Methods 21 <sup>st</sup> edition] to mean measured summer D.O. during 1990's)	<i>Chlorophyll assessment less accurate and precise.</i>
Environmental Variability (1)	Higher (% 116.5 ± 14.0 [spring], %122.3 ± 9.3 [summer])	Lower (% 15.5 ± 0.9 [summer])	<i>Chlorophyll assessment less accurate and precise.</i>
Model Calibration	Lower Accuracy	Higher Accuracy	<i>Chlorophyll TMDL model predictions less accurate.</i>
Model Prediction Ability	Lower Accuracy	Higher Accuracy	<i>Chlorophyll TMDL model predictions less accurate.</i>

1) Average and range of coefficient of variation for four 3-year assessment periods from 1990 to 1998.

**Attachment B**

CBP Segment	2008 IR Arith Mean % non-attain	2008 IR Arith Mean Status	2008 IR Geo Mean % non-attain	2008 IR Geo Mean Status	2010 IR Arith Mean % non-attain	2010 IR Arith Mean Status	2010 IR Geo Mean % non-attain	2010 IR Geo Mean Status
JMSTF1 (James TF Lower) Spring	39	Fails	11	Fails	9	Fails	9	Fails
JMSTF1 (James TF Lower) Summer	47	Fails	46	Fails	33	Fails	31	Fails
JMSTF2 (James TF Upper) Spring	27	Fails	25	Fails	14	Fails	7	Fails
JMSTF2 (James TF Upper) Summer	25	Fails	25	Fails	41	Fails	31	Fails
JMSOH (James Oligohaline) Spring	21	Fails	7	Fails	7	Fails	1	Fails
JMSOH (James Oligohaline)Summer	0	Meets	0	Meets	0	Meets	0	Meets
JMSMH (James Mesohaline) Spring	30	Fails	17	Fails	9	Fails	0	Meets
JMSMH (James Mesohaline) Summer	25	Fails	17	Fails	9	Fails	1	Fails
JMSPH (James Polyhaline) Spring	21	Fails	7	Fails	0	Meets	0	Meets
JMSPH (James Polyhaline) Summer	30	Fails	9	Fails	8	Fails	0	Meets

Note: Above 303(d) assessment results for James River segments are shown with both "old" assessment method (Arith Mean) and "new" assessment method (Geo mean). The 2008 Integrated Report uses monitoring data from 2004 through 2006. The 2010 Integrated Report uses monitoring data from 2006 through 2008. Only "old" method results are reported in the actual published Integrated Reports because "new" method is not yet formally adopted in WQS. Monitoring data used for both periods were combination of both dataflow and fixed site samples. Some segments/periods have a lot of dataflow data available (e.g. JMSPH for both 04-06 and 06-08 periods), others have much less or no dataflow data available (e.g. JMSTF for 06-08 period).